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(54) Web forming method and apparatus.

(57) A method for forming a paper or paperboard web from a fibrous material in the wire section of a paper making machine or equivalent machine comprising a bottom wire loop (2;102) with the main portion of its top run being horizontal or substantially horizontal, and a top wire loop (10;110) working in conjunction with the bottom wire loop; wherein in the method fibre slurry coming out of the headbox (1;101) of the paper making machine is fed to the first part (2a; 102a) of the top run of said bottom wire loop (2;102), which forms the first dewatering zone after which the partly formed fibre layer is led to the second dewatering zone, in the area of which said top wire loop (10;110) moves to cover said partly formed fibre layer in such a way that water removal from the fibre layer continues it least in two stages in the area of said second dewatering zone, whereupon the top wire loop (10;110) is separated from the nearly formed web (W) that is led to follow the run of the bottom wire loop (2;102) forward to the next processing stages of the web (W), wherein the method is **characterized** in that in the single-wired dewatering zone (2a;102a), after the initial water removal is carried out through the bottom wire (2;102), water removal through the bottom wire (2;102) is prevented by means of an element group (9; 109) operating in contact with the inner surface of the horizontal top run of the bottom wires; that in said water-removal prevention area water is removed from the web (W) through the top wire in the first stage or stages of the double-wired second dewatering zone, which stages comprise a relatively long, planar wire table extending from the headbox to the forming roll (6 in Fig. 1), or from the headbox to the last supporting element (109 in Fig. 2); and that after the first dewatering stage or stages of the double-wired zone water is removed in a curved double-wired dewatering zone (b) (Fig. 1) or zones (R_o, C) (Fig. 2), after which the web (W) is led to follow the bottom wire (2;102).

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WEB FORMING METHOD AND APPARATUS

The object of the invention is to provide a method for forming a paper or paperboard web from fibrous material. The method is to be applied in the wire section of a paper making machine or equivalent comprising a bottom wire loop with the main portion of its top run being horizontal or substantially horizontal, and of a top wire loop working in conjunction with the bottom wire loop. In the method fibre slurry coming out of the headbox of the paper making machine is fed to the first part of the top run of said bottom wire loop, which forms the first dewatering zone. After that the partly formed fibre layer is led to the second dewatering zone, in the area of which said top wire loop is made to cover the partly formed fibre layer in a way that water removal from the fibre layer continues at least in two stages in the area of said second dewatering zone. Then the top wire loop is separated from the nearly formed web that is led to follow the run of the bottom wire loop forward to the next processing stages of the web.

Furthermore, the object of the invention is a web forming apparatus for putting the method of the invention into effect. The apparatus comprises a bottom wire loop with the main portion of its top run being horizontal or substantially horizontal and a top wire loop working in conjunction with the bottom wire loop, as well as a headbox that is arranged to feed the jet of fibre slurry to the single-wired first part of the top run of the bottom wire loop, after which there is a double-wired forming zone that is limited between the common travels of the bottom and top wires. In this zone, inside the bottom wire loop and the top wire loop there are different elements and element groups affecting the water removal.

According to the oldest methods for forming continuous paper or paperboard webs, which are still most commonly applied, forming of the web takes place on a so called horizontal fourdrinier wire section. In these methods water is removed from fibre slurry only in one direction downwards at the full length of the wire section. Due to the operating principle of such wire section the top and bottom sides of the finished sheet have different properties, i.e. the top side of the paper is smoother than the bottom side where pattern or wiremarking, caused by the forming wire, can be seen more or less clearly. The top and bottom sides of the sheet also differ from each other as to the fibre composition; the top side of the web contains fine and short fibres and fillers much more than the bottom side from which a considerable amount of fines have been drawn during and as a result of the one-way dewatering process. The difference between the paper sides is not detrimental when for instance wrapping paper or packaging cardboard is concerned. It is important that the sides of paper meant e.g. for printing of books and newspapers equal each other for the fibre composition and other properties as well as possible. The difference between the paper sides is called two-sidedness.

A large number of paper machine types designed especially for reducing the two-sidedness of paper are known. Amongst these types two main groups can be distinguished, i.e. the actual twin-wire formers and the so called hybrid formers. Web formation on the actual twin-wire formers takes place from beginning to end between two wires. On the hybrid formers the web is formed at first on one wire, after which the partly formed web is led to the dewatering zone formed between the two wires where the final mutual position of the fibres is stabilized.

One advantage of the hybrid formers is that they can be created from the existing fourdrinier wire sections by means of rather simple modifications. The most essential change is to place the top wire loop in the middle or last part of the bottom wire top run in order to work with it together. This will allow - in addition to the fact that the quality of the resultant paper can be improved - a more efficient water removal on the wire section and by that means also the increase of the paper machine speed. One hybrid former of this kind has been disclosed in the FI-application 820742 of the applicant, in the first place meant for producing newsprint and similar printing grades with a working speed up to and over 900 metres per minute.

A significant weakness of the above mentioned formers is the fact that they are not in general suitable for producing heavy paper and board grades. This is since at the beginning of the double-wired portion following the first dewatering zone of the single wire, the run of the wires and the fibre layer between them, partly already formed as a web, is at once caused to curve quite sharply either over the surface of the rotating roll or the stationary so called forming shoe. Curving causes internal fracturing which becomes larger as the web becomes thicker. This means that the fibre layer is exposed to water removal pressure between the wires, which pressure is in direct ratio to the tension of the outer wire and in inverse ratio to the radius of curvature of the surface in question.

The space arrangements and other structural factors cause that in the well-known hybrid formers, e.g. in the FI-application 820742, the radius of curvature of the reversal element of the wires, that is the shoe or the roll, is so small that the rather

sudden compressing effect directed to the forming web is far too great in case that heavier grades of paper and board are manufactured on the former in question. Too heavy a compression causes in this case damage to the fibre layers and decreases the properties of the finished product, especially its strength, but also for instance the printability. In the worst case too heavy a compression results in so called "splashing" of the web and causes a production break.

The purpose of this invention is to create a wire section of a paper making machine of hybrid former type as well as a method to be applied in it, in which special attention has been paid to eliminating or minimizing the problems in connection with the production of heavier grades of paper and board. The construction according to the invention also allows the production of lightweight paper grades at high speeds; therefore, the hybrid former applying the invention is meant to be operative in a very wide basis weight area, that is even 50-1000 grams per square metre.

The purpose of the invention is further to create an apparatus by means of which the water removing pressure directed to the fibre layer increases progressively in the running direction of the wires.

For achieving the goals described above and to be explained closer later, the method according to the invention is mainly characterized in that when the initial water removal has been carried out through the bottom wire in the single-wired dewatering zone, the water removal through the bottom wire is prevented by means of an element group operating in contact with the inner surface of its horizontal top run; that in said water-removal prevention zone water is removed from the web through the top wire in the first stage or stages of the second double-wired dewatering zone, which stages form a linear and relatively long extension to the single-wired zone; and that after the first dewatering stage or stages of the double-wired zone the water removal is carried out in the curved double-wired dewatering zone or zones, after which the web is made to follow the bottom wire.

The apparatus according to the invention is characterized in that the double-wired second dewatering zone extends over a relatively long first planar part and an immediate extension to the single-wired part of the wire former, after which double-wired planar part the double-wired zone curves or bends over the guiding surface of the stationary and/or rotary guiding element.

In a favourable embodiment of the invention the linear first stage of said double-wired portion is equipped with a two-part dewatering device comprising wire supporting elements inside the bottom wire loop and a suction chamber system located in the equivalent area inside the top wire loop.

The first single-wired dewatering zone in this invention is most suitable when it is relatively short and the dry content as a result of water removal in its area before the first part of the second dewatering zone is approximately 1-4 per cent. Due to the shortness of the first dewatering zone only a few dewatering elements, such as foils, are needed to support it; therefore, the effect of water flow removing fine substances and directed perpendicularly to the forming web is of minor effect here. In this zone the friction caused by the dewatering elements against the wire is also insignificant which, for its part, reduces the wear of the wire and the need of energy on the wire section.

The second dewatering zone which comprises two wires may, depending on the construction variation applied in each case, include several, minimum two, stages with different operations. The first of these stages is, deviating from the conventional hybrid former technology, a linear immediate extension to the first single-wired dewatering zone. In the area of this first stage the top wire loop is made to approach the bottom wire loop and the fibre layer on its surface at acute angle, e.g. 2-5 degrees. In this stage the water removal pressure directed to the partly formed web is rather slight, which means that the careful dewatering process continues. The point where the top wire loop meets the fibre layer can vary depending e.g. on the intersecting angle and thickness of the fibre layer. To prevent the web forming section being too long as a whole, water removal has, however, to be intensified, but still very carefully. Furthermore, water removal should in this stage be forcibly directed to take place through the top wire loop, in which case the dewatering device located inside the top wire loop and disclosed in the SE-application 8703468 of the applicant can be used. The first part of the device in question is a water doctor of so called auto-slice type, which is combined with a corresponding water collection chamber connected favourably to the suction source. The dewatering device further incorporates at least one water collection pit arrangement that comprises several foils and is connected to the suction source. Opposite to this dewatering device located inside the top wire loop there is further, inside the bottom wire loop, a set of wire supporting elements which are on the one hand meant for reducing the water removal through the bottom wire and on the other hand for directing pressure in this area to the fibre layer between the top and bottom wires - in other words to the partly formed web - in order to increase the water removal and the suitable pulse of the pressure, thanks to which the formation of the web improves. These wire supporting elements are loaded against each bottom wire loop e.g. by

means of pneumatic hoses. Compression against the web is thus self-adjusting. One essential advantage of this arrangement is that the water removing pressure directed to the fibre layer between the wires is increased in the desired way gradually in the running direction of the wires without a sudden pressure peak at the beginning of the double-wired portion as is the case on conventional hybrid formers.

When the forming web has reached a dry content of 5-10 per cent after the first stage of the second dewatering zone, which is naturally dependent on the basis weight of the paper or paperboard to be made and on the speed of the machine, a stronger compression than before can be directed in this stage towards the web between the top and bottom wires. This is created by leading the travel of the web over one or more curved surfaces which can be either rotating or stationary. The curved travel of the web in one or several stages forms the second stage in the second dewatering zone. After this stage the dry content of the web is 14-16 per cent depending on the production conditions, and in this stage the top wire can be separated from the web supported by the bottom wire, after which the web continues its travel forward to the next stages of the process, for instance into the press section of the paper machine.

The invention is described below in detail with reference to some examples of the embodiments shown in the enclosed figures. The invention is not, however, limited to the details of the examples in a narrow sense.

Fig. 1 is a schematic side elevation of a web forming apparatus comprising a first embodiment according to the invention;

Fig. 2 is a similar illustration of web forming apparatus for applying the invention;

Fig. 3A is a schematic side elevation of a dewatering device which is installed inside the top wire loop;

Fig. 3B is a similar illustration of a variant of the dewatering device according to Fig. 3A:

Fig. 4A is a fragmentary detail on enlarged scale of a so called auto-slice device that is part of the dewatering device shown in Figs. 3A and 3B; and

Fig. 4B illustrates an alternative variation of the device detail shown in Fig. 4A.

The web forming apparatus shown in Fig. 1 comprises a headbox 1 and a bottom wire loop 2, the travel of which is mainly guided by a breast roll 3, wire guide rolls 4, a forming roll 6 and a couch roll 7. Inside the bottom wire loop, in the first dewatering zone there is also a dewatering element group 5 and in the area of the second dewatering zone a wire supporting element group 9, 9b, 9c as well as a suction box 8 which is located between the forming roll 6 and the couch roll 7 on the downwardly inclined portion of the bottom wire run.

The web forming apparatus further comprises a top wire loop 10 which is guided by guide rolls 11, 11a and 11b and which covers the bottom wire loop in the area of the second dewatering zone. Inside the top wire loop there is further a dewatering device 12 that is shown in more detail in Figs. 3A and 3B. The first part of the device 12 is a water removing doctor of auto-slice type that is connected to the suction chamber in a previously known manner. Furthermore, the dewatering device comprises two water collection pits with the bottom part formed as foil blades which are in contact with the top wire 10.

The operation of the web forming apparatus is as follows: The headbox feeds the stock to the horizontal first part 2a of the bottom wire loop 2 that is the first dewatering zone, in which area water removal takes place carefully by means of suitable and relatively few water removing elements 5. The fibre layer W formed on the surface of the bottom wire loop 2 continues its travel to the second dewatering zone which is formed while the top wire loop 10 is directed close to the bottom wire loop 2 at a narrow angle a. The most suitable gradient of the angle is 2-5 degrees which is obtained by adjusting the position of the guide roll 11a of the top wire 10 vertically (as marked with an arrow).

The second dewatering zone is divided into several stages. The dewatering device 12 located inside the top wire loop and the inside wire supporting elements 9 of the bottom wire loop 2 working in conjunction with it form the first stage of the second dewatering zone. The first dewatering zone 2a and the relatively long first stage of the second dewatering zone are in the same horizonal plane up to the forming roll 6 that deflects the travel of the wires 2 and 10 downwards at an angle as large as the sector b where the common travel of the wires 2 and 10 is guided by the forming roll 6. The sector b is the third stage of the second dewatering zone. Compression between the wires 2 and 10 removes further water from the forming web W. Water is thrown by centrifugal force into a water collection pit 13 and removed through a channel 13a. Between the forming roll 6 and the couch roll 7 the wire 10 is separated by means of the roll 11b from the web W running on top of the wire 2, and the web continues its travel up to the roll 7. The suction box 8 is for the purpose of ensuring that the web W does not follow the wire 10 that returns to the roll 11a. Close to the couch roll 7 there is a pick-up roll 14 with a felt 15, by means of which the web W is transferred from the forming section into the press section (not shown).

The web forming apparatus illustrated in Fig. 2 comprises a headbox 101 and a bottom wire loop 102, the travel of which is mainly guided by a breast roll 103, forming roll 106, couch roll 107 and wire guide rolls 104. The web forming section of Fig. 2 also comprises a top wire loop 110 and wire guide rolls which guide the travel of the top wire loop and are marked with reference numbers 111, 111a, 114, and a dewatering device 112.

The web forming apparatus of Fig. 2 mainly functions in the same way as the one shown in Fig. 1. An essential difference between the embodiments of the Figs. 1 and 2 is in the construction and operation of the dewatering devices 12 and 112 as well as in the positioning of the forming rolls 6 and 106 compared to the main horizontal wire plane T-T of these web forming sections. The end part of the dewatering device 112 curves upwards and leads the common travel of the wires 102 and 110 to the forming roll 106, the highest point of which is substantially above the main horizontal plane T-T of the wire 102. Compression between the wires 102 and 110 in the area of the forming roll 106 removes water from the web W which is under forming process, and the water is thrown into a water collection pit 113. The travel of the runs of wires 102 and 110 is returned to the original plane T-T by means of a wire guide roll 114. The top wire loop 110 separates from the travel of the wire 102 in the same way as in the solution of Fig. 1. The bottom wire 102 together with the web W is supported by a suction box 108 and moves over a couch roll 107 to the run between this roll and a drive roll 104a, from which the web W can be moved by means of a pick-up roll 14 and a pick-up felt forward into the press section of the paper machine in the way known per se.

Fig. 3A illustrates a dewatering device 12 of a forming section according to Fig. 1 showing its most important construction details, and a supporting element group 9 of the bottom wire cooperating with it.

The dewatering device 12 comprises an integrated combination of three suction and water collection chambers 16, 17 and 18, in which the different chambers are separated from each other by partitions 17b and 18b. An air opening 19 and a discharge water channel 20 are connected to the suction source (not shown) in each chamber 16, 17 and 18. A water collection channel 16a that is part of the first suction chamber 16, is formed between the main beam 16b and the deflector 16c of the dewatering device. At the lower end of the channel 16a there is a transverse foil doctor 21 and a blade 22 which is adjustable by means of rods 23. These form a slice A that extends over the width of the wire former and can be adjusted in cross-sectional profile. Through this slice the water compressed through the fibre layer between the wires 2 and 10 is thrown into the first chamber 16.

The foil doctor 21 of the device 12 shown in Fig. 3A is followed by a group of equivalent foils 21′ and 21″ with their bottom surfaces in the same plane. The water separated from the fibre layer is collected by the foils under the suction chamber 16 and led into the suction chamber 17 through a channel 17a that is formed between the partition 17b and the deflector 17c. Correspondingly, the water collected by the next foils 21″ is led into the third suction chamber 18 through a channel 18a that is formed between the back wall 18d and the deflector 18c of the dewatering device.

The channel 16a of Fig. 3A and the foil doctor 21 with the blade 22 adjustable in relation to said doctor form together a so called auto-slice dewatering element. When the wire section is run at a high speed during the manufacture of lightweight paper grades, the water separated from the web W penetrates the channel 16a mainly by its own kinetic energy, and further the suction chamber 16. When heavier board grades are produced on the former at low speeds, the operation of the auto-slice system has to be assisted by a stronger suction, the most suitable vacuum being 6-8 kilopascal. In this stage the amount of water to be removed and directed upwards can be affected by adjusting the height of the slice A between the blade 22 and the foil 21. The same applies partly to the grade of the vacuum balance.

The dewatering effect of the auto-slice element of Fig. 3A with the first suction chamber 16 is local and limited close to the leading edge of the first foil doctor 21. The dewatering area of the second suction chamber 17 is wider and determined by the number of foils 21′, which, as an example, are four in Fig. 3. The effect of the foils 21′ is based on cooperation with the wire supporting elements 9 located inside the bottom wire loop 2. The supporting elements 9 have been described in more detail in Fig. 4A. It is very important to these supporting elements 9 and their operation that they can be used in the area of the dewatering device 12 for creating in a desired way compression of the bottom wire 2 which increases gradually and is directed to the forming web W and which causes the water removal from the web W to take place mainly through the top wire loop 10 into the suction channel 17a and through it into the suction chamber 17. The operation of the third suction chamber 18 is analogous to the second suction chamber 17.

The underpressure prevailing in the second and third chambers 17, 18 of Fig. 3A is considerably stronger than that in the first chamber, that is 10-20 kilopascal in the chamber 17 and approximately 15-30 kilopascal in the chamber 18 depending on the quality of the web to be made.

Fig. 3B illustrates the dewatering device 112 of the wire section of Fig. 2. This is substantially equivalent to the dewatering device 12 of Fig. 3A as far as the construction and operation are concerned. For this reason mainly the same reference numbers as for Fig. 3A are used for describing Fig. 3B.

The most essential difference between the dewatering devices 12 and 112 of Fig. 3A resp. 3B is the fact that in the construction of the latter the last foils 124' in the suction channel 118a of the third suction chamber 118 have been arranged to make up a contour curving upwards in order to guide the travel of the wires 110 and 102 to the forming roll 106 shown in Fig. 2. Another difference is in the length of the wire supporting element section 9, 9b, 9c. The supporting members (a) of the bottom wire 2;102 with the top sides in contact with the bottom wire 2;102 form together a substantially planar continuous surface and are necessary and useful only at the location opposed to the suction chambers one (16) and two (17) of the device 112 located on the upper side of the wires 102, 110 or 2, 10 (Fig. 3B), while in the device 12 shown in Fig. 3A they are possible even under the chamber 18.

The function of the suction chambers in the dewatering devices 12 and 112 of Figs. 3A and 3B is in principle identical. Therefore, it is not necessary to explain the construction and operation of the equipment of Fig. 3B in more detail herein.

Fig. 4A is a fragmentary detail of an auto-slice section of the dewatering devices 12, 112 and the internal wire supporting element system 9 of the bottom wire 2 cooperating in connection with another.

The water-removal process in the devices of Figs. 3A and 4B takes place as follows: The fibre layer W formed partLy on the surface of the bottom wire loop 2 in the first dewatering zone 2a of the wire former comes to the gap between the wires 2 and 10, the angle of which is determined by the height position of the roll 11a guiding the wire 10 and being adjustable as to its position. The surface of the fibre layer meets the top wire 10 near the point B (Fig. 4A). This is also the position of the leading edge of the wire supporting system 9 supporting the bottom wire loop 2, by the action of which the water removal from the fibre layer starts mainly upwards. The elements 9 of the system are supported flexibly on the longitudinal supporting beam 9c through rubber hoses $9b_1$, $9b_2$, $9b_3$, $9b_4$... pressurized with air. The pressure in the hoses $9b_1$... can be regulated so that the loading of the elements against the bottom wire 2 and the fibre layer increases gradually in the running direction of the wires 2 and 10. A fairly low pressure is used in the hoses $9b_1$..., e.g. 10-50 centimetres H_2O; then compression directed to the forming web W is rather slight and the water removal pressure is self-adjusting. The surface of the elements 9 has grooves 9R extending across the whole width of the wire 2 and allowing a slight water removal even through the bottom wire. The water removal process continues in the area between the point B and the adjustable blade 22. A film of water is formed on the inner surface of the top wire 10 collecting in a sharply wedge-shaped space between the wire 10 and the blade 22 and the slice A between the blade 22 and the foil 21. Water is drawn through the slice A and the channel 16a into the first chamber 16 of the dewatering device, either by effect of its kinetic energy and/or the vacuum prevailing in the chamber. The blade 22 is adjustable in height by means of the adjusting device 23; this allows that the water amount and possibly even the air amount coming into the channel 16a can be regulated. The adjustments in question regarding both the intersecting angle a between the wires 2 and 10 (Fig. 1) and the slice A leading to the channel 16a, as well as the regulation of the pressure applied by the supporting system 9 are naturally dependant on the paper or paperboard grade to be manufactured.

The auto-slice system of Fig. 4A based on the use of the adjustable blade 22 can in certain cases be replaced by the construction shown in Fig. 4B; then the adjustable blade has been replaced by the roll 22A. The speed of rotation and the height position of the roll, i.e. the distance from the wire 10, is arranged to be adjustable. The variable speed drive device of the roll 22A is marked with reference number 22B.

The following claims allow modifications concerning the details of the invention, to encompass even such ones which are not exactly the same as described in the previously given examples.

Claims

1. A method for forming a paper or paperboard web from a fibrous material in the wire section of a paper making machine or equivalent machine comprising a bottom wire loop (2;102) with the main portion of its top run being horizontal or substantially horizontal, and a top wire loop (10;110) working in conjunction with the bottom wire loop; wherein in the method fibre slurry coming out of the headbox (1;101) of the paper making machine is fed to the first part (2a;102a) of the top run of said bottom wire loop (2;102), which forms the first dewatering zone after which the partly formed fibre layer is led to the second dewatering zone, in the area of which said top wire loop (10;110) moves to cover said partly formed fibre layer in such a way that water removal from the fibre layer continues at

least in two stages in the area of said second dewatering zone, whereupon the top wire loop (10;110) is separated from the nearly formed web (W) that is led to follow the run of the bottom wire loop (2;102) forward to the next processing stages of the web (W), wherein the method is **characterized** in that in the single-wired dewatering zone (2a;102a), after the initial water removal is carried out through the bottom wire (2;102), water removal through the bottom wire (2;102) is prevented by means of an element group (9; 109) operating in contact with the inner surface of the horizontal top run of the bottom wires; that in said water-removal prevention area water is removed from the web (W) through the top wire in the first stage or stages of the double-wired second dewatering zone, which stages comprise a relatively long, planar wire table extending from the headbox to the forming roll (6 in Fig. 1), or from the headbox to the last supporting element (109 in Fig. 2); and that after the first dewatering stage or stages of the double-wired zone water is removed in a curved double-wired dewatering zone (b) (Fig. 1) or zones (R_o, C) (Fig. 2), after which the web (W) is led to follow the bottom wire (2;102).

2. A method according to claim 1, **characterized** in that the double-wired second dewatering zone is divided into at least two successive stages, where in the area of the first or two first stages water removal is prevented through the bottom wire (2,102) by means of self-adjusting supporting elements (9;109) placed in the plane (T-T) of the single-wired first part (2a;102a); that water removal close to said supporting elements (9;109) is performed through the top wire assisted by the suction and/or foil elements (21, 21′, 21″).

3. A method according to claim 2, **characterized** in that the last water removal stage to be carried out between the two wires (2, 102, 10, 110) takes place in the double-wired zone (b,c) which curves downwards and is guided by the forming roll (6, 106) located inside the bottom wire loop (Fig. 1).

4. A method according to claim 3, **characterized** in that after the first water-removal preventing stage or stages of the double-wired zone said double-wired zone is led to curve (R_o) upwards by the action of the guiding elements located inside the top wire loop (110), after which the double-wired zone is led to curve downwards guided by the forming roll (106) or equivalent.

5. A method according to any of claims 1-4, **characterized** in that the method applies a relatively short single-wired dewatering zone (2a;102a), in the area of which water is removed to such extent that the dry content of the web (W) before the double-wired dewatering zone is in the range of 1-4 per cent, the most suitable range being 2-3 per cent.

6. A web forming apparatus for carrying out a method according to any of claims 1-5, comprising a bottom wire loop (2;102) with the main portion of its top run being horizontal or substantially horizontal, and a top wire loop (10;110) working in conjunction with the bottom wire loop, as well as a headbox (1;101) that is arranged to feed a jet (J) of fibre slurry to the single-wired first part (2a;102a) of the top run of the bottom wire loop, after which there is a double-wired forming zone that is limited between the common travels of the bottom wire (2;102) and the top wire (10, 110), and in which forming zone, inside the bottom wire loop, there are different elements and element groups (9, 6, 8 or 109, 106, 108) and inside the top wire loop respectively there are elements (12 or 112) affecting the water removal, **characterized** in that the double-wired second dewatering zone extends over a relatively long first planar part and as an immediate extension of the single-wired first part (2a;102a) of the wire table, and after which the double-wired zone curves over the guiding surface of the stationary and/or rotary guiding element.

7. An apparatus according to claim 6, **characterized** in that in said planar first stage of the double-wired dewatering zone there are devices for both water removal and water removal prevention located on the opposite sides of the wires and cooperating with another, comprising the self-adjusting supporting elements (9;109) of the bottom wire, located inside the bottom wire loop and arranged also to work as water-removal prevention members, and the suction chamber and foil elements (12;112) placed in the opposite location inside the top wire loop.

8. An apparatus according to claim 6 or 7, **characterized** in that the self-adjusting cross members or beams supported by the loading hoses or equivalent act as preventing members of water removal; the cross members or beams extending over two or three suction chambers (16, 17, 18) and over the foils (21, 21′, 21″) controlling the top wire (10, 110).

9. An apparatus according to claim 8, **characterized** in that in connection with the front wall of the dewatering device (12,112) located inside the top wire loop (10,110) there is an auto-slice arrangement and a suction channel (16a) which is directed upwards and opens into the first suction chamber (16); and that on the inlet of said suction chamber (16a) there is a blade (22) which possibly is adjustable in height level by a device (23) (Fig. 4A).

10. An apparatus according to any of claims 6-8, **characterized** in that the inlet part of the auto-slice channel (16a) of the first suction chamber (16) of the dewatering device (112) inside the top wire

loop (10) is on its top side limited by a rotating variable speed roll (22A), the position of which can be arranged adjustable in vertical direction (Fig. 4B).

11. An apparatus according to any of claims 6-10, **characterized** in that in the area of the last chamber (118) of the dewatering device (112) located inside the top wire loop (110) the double-wired zone is arranged to curve upwards guided by foil blades or equivalent stationary elements (Fig. 3B), after which the double-wired zone is arranged to curve downwards on the surface of a forming roll (106) or equivalent and to return to the level (T-T) of the single-wired first part (102a) (Fig. 2).

12. An apparatus according to any of claims 6-10, **characterized** in that the dewatering device (12) inside the top wire loop (10) comprises a unit that is provided with minimum two, preferably three successive suction chambers (16, 17, 18) with the foil blades (21, 21′, 21″) on the bottom part arranged to control the double-wired dewatering zone as an extension to the single-wired first part (21, 102); that there is a supporting beam arrangement (9) under said planar portion; and that after said dewatering device (12) the double-wired zone bends downwards over a forming roll (6) or an equivalent stationary sector (b), after which there is a planar suction box (8) inside the bottom wire loop (2) ensuring that the web (W) follows the bottom wire (2) (Fig. 1).

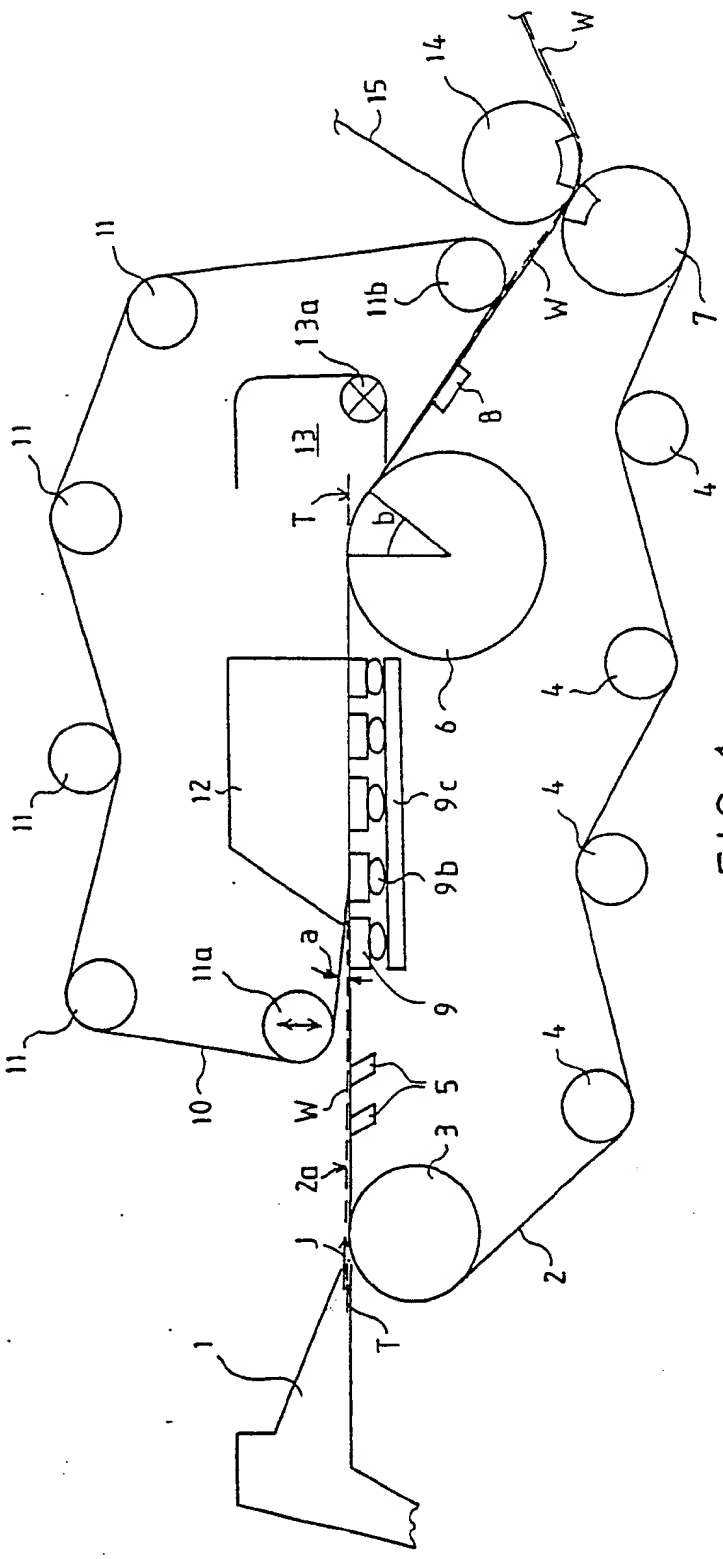

FIG. 1

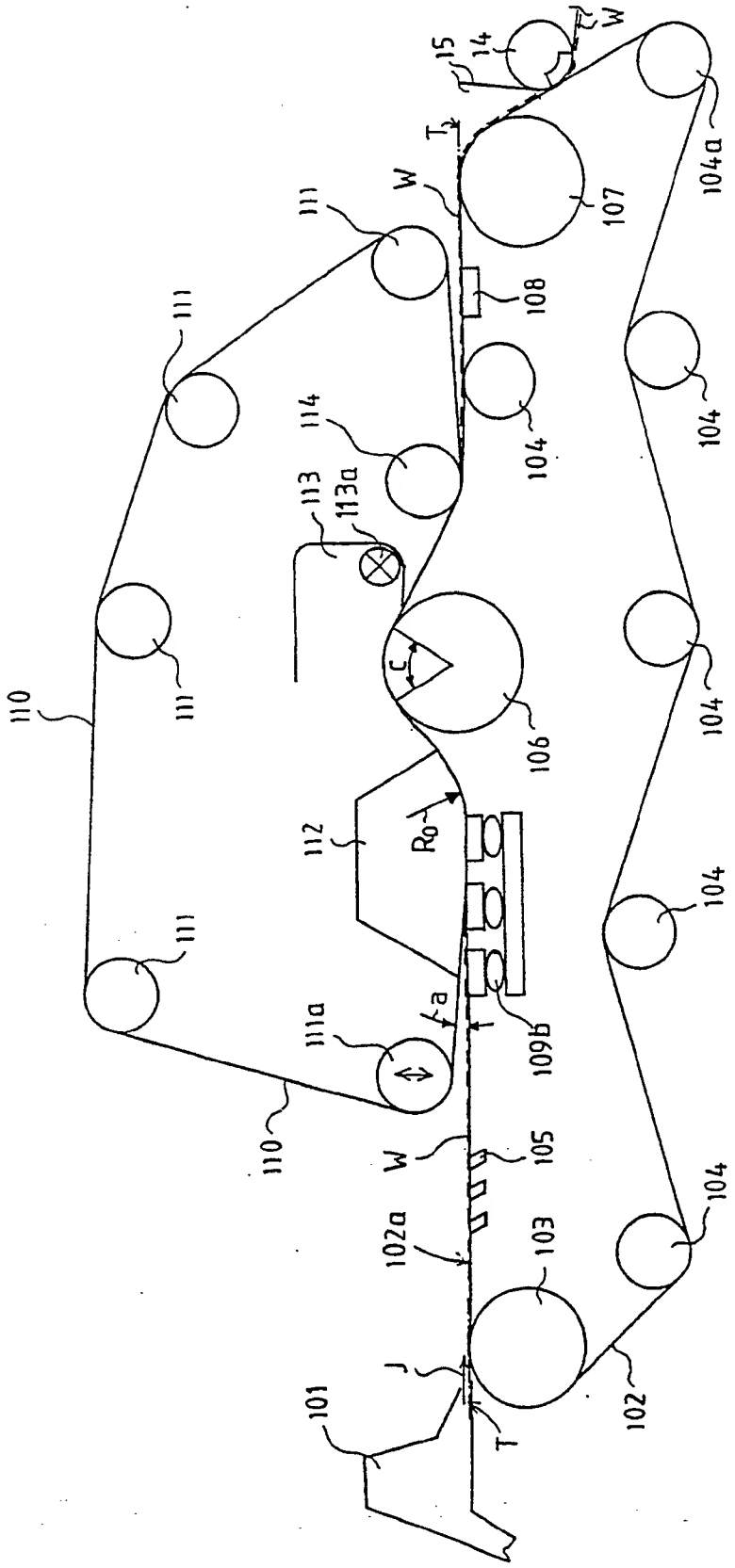

FIG. 2

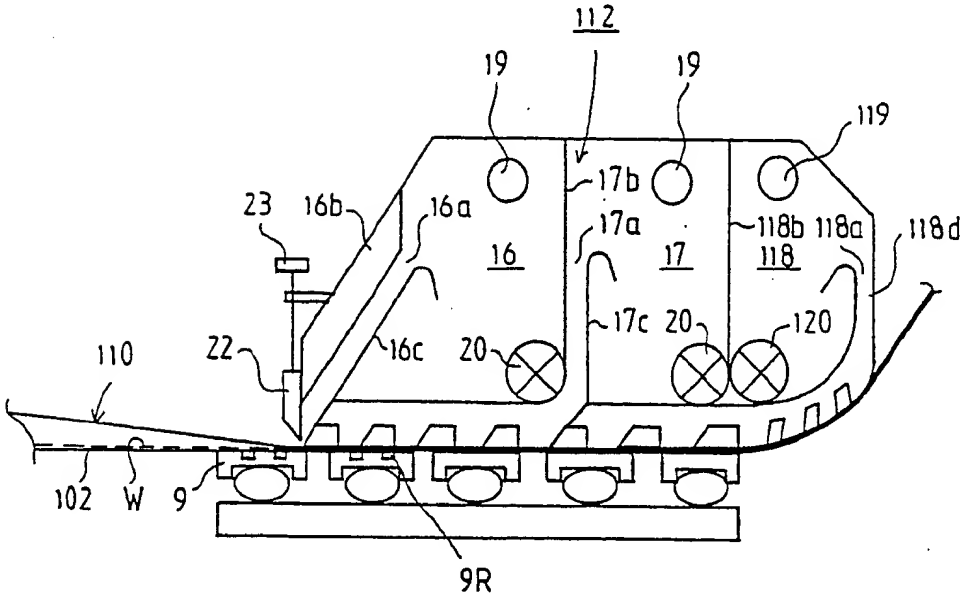
112
19
19
119
23
16b
16a
17b
17a
118b
118a
118d
16
17
118
17c
20
20
120
110
22
16c
20
102
W
9
9R

FIG. 3B

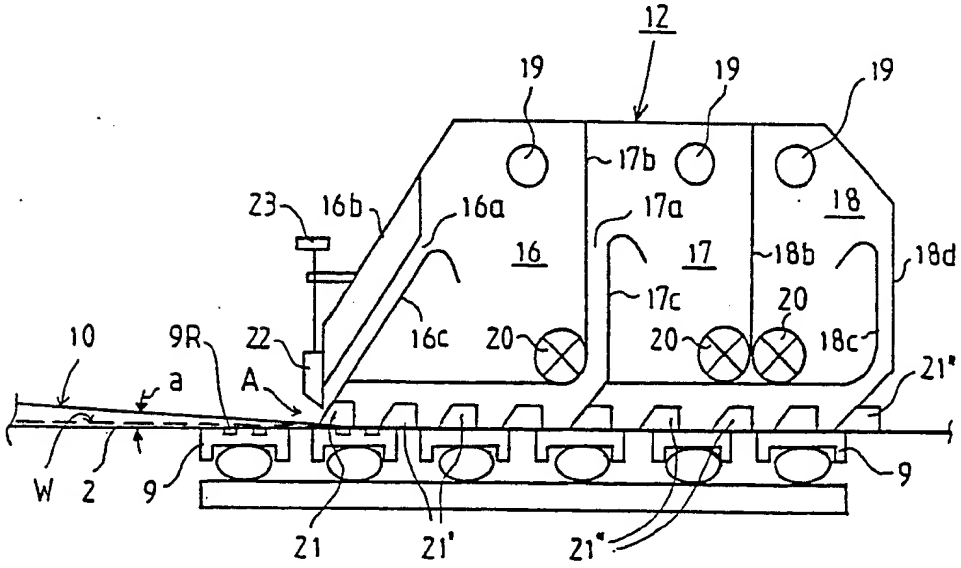
12
19
19
19
17b
23
16b
16a
17a
18
16
17
18b
18d
17c
20
10
9R
22
16c
20
20
18c
a
A
21"
W
2
9
9
21
21'
21"

FIG. 3A

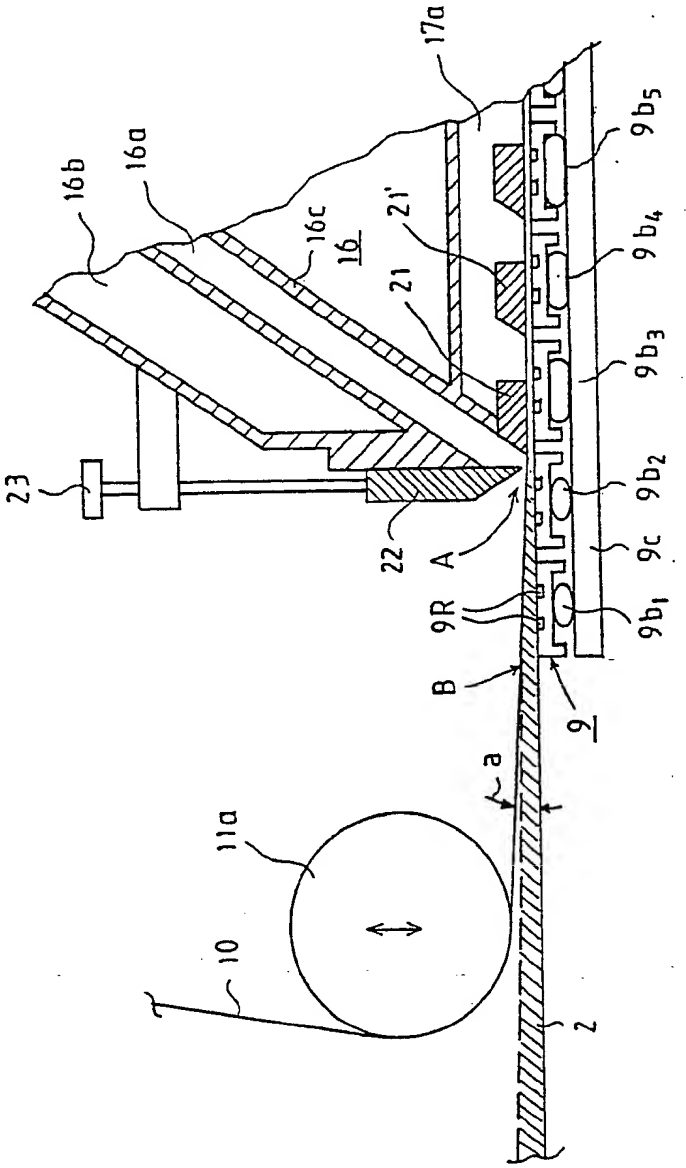

FIG. 4A

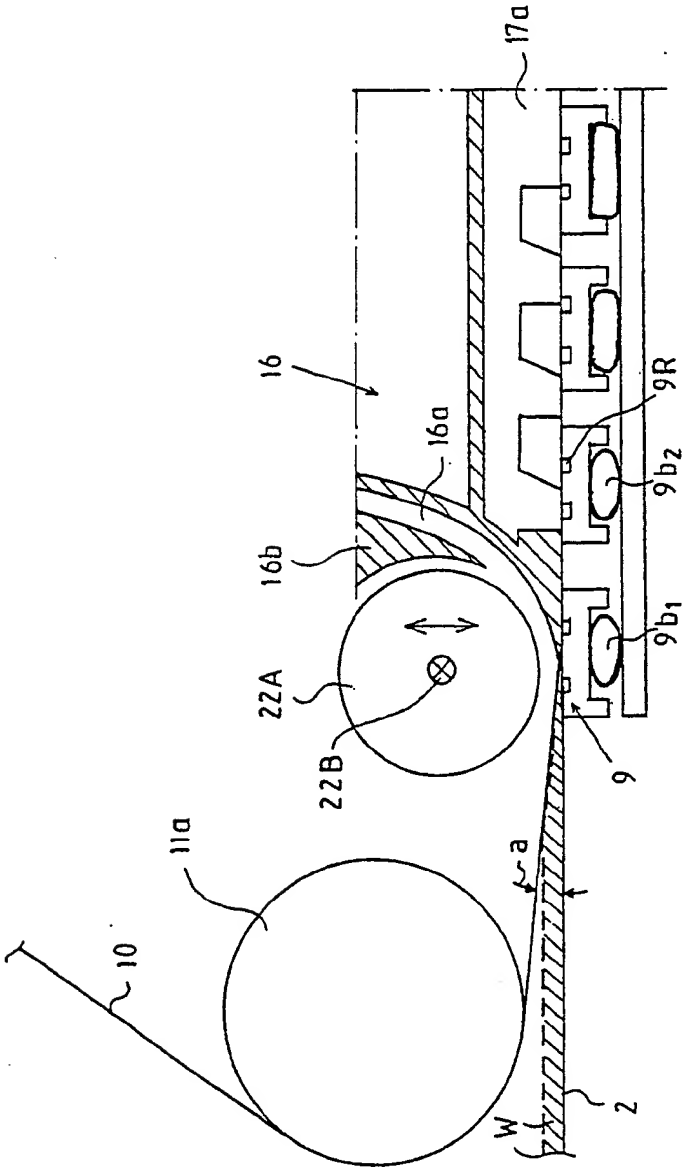

FIG. 4B

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(54) Web forming method and apparatus.

(57) A method for forming a paper or paperboard web from a fibrous material in the wire section of a paper making machine or equivalent machine comprising a bottom wire loop (2;102) with the main portion of its top run being horizontal or substantially horizontal, and a top wire loop (10;110) working in conjunction with the bottom wire loop; wherein in the method fibre slurry coming out of the headbox (1;101) of the paper making machine is fed to the first part (2a; 102a) of the top run of said bottom wire loop (2;102), which forms the first dewatering zone after which the partly formed fibre layer is led to the second dewatering zone, in the area of which said top wire loop (10;110) moves to cover said partly formed fibre layer in such a way that water removal from the fibre layer continues it least in two stages in the area of said second dewatering zone, whereupon the top wire loop (10;110) is separated from the nearly formed web (W) that is led to follow the run of the bottom wire loop (2;102) forward to the next processing stages of the web (W), wherein the method is **characterized** in that in the single-wired dewatering zone (2a;102a), after the initial water removal is carried out through the bottom wire (2;102), water removal through the bottom wire (2;102) is prevented by means of an element group (9; 109) operating in contact with the inner surface of the horizontal top run of the bottom wires; that in said water-removal prevention area water is removed from the web (W) through the top wire in the first stage or stages of the double-wired second dewatering zone, which stages comprise a relatively long, planar wire table extending from the headbox to the forming roll (6 in Fig. 1), or from the headbox to the last supporting element (109 in Fig. 2); and that after the first dewatering stage or stages of the double-wired zone water is removed in a curved double-wired dewatering zone (b) (Fig. 1) or zones (R_o, C) (Fig. 2), after which the web (W) is led to follow the bottom wire (2;102).

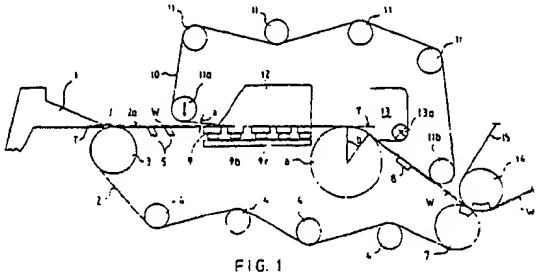

FIG. 1

EP 0 371 786 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 31 2431

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-136000 (BELOIT) * the whole document *	1-4, 9	D21F1/48 D21F9/00
A	DE-A-2808939 (VOITH) * the whole document *	1, 2, 7	
A	DE-A-3315023 (VALMET OY) * the whole document *	1, 2	
A	FR-A-2510153 (FELDMUHLE) * the whole document *	1, 6	
A	WO-A-8303109 (VALMET OY) * the whole document *	1	
A	DE-A-3329833 (AHLSTRÖM OY) * the whole document *	10	
P,A	WO-A-8904397 (SULZER-ESCHER WYSS) * the whole document *	1, 2, 7, 9	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 SEPTEMBER 1990	DE RIJCK F.

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